Traditional Ecological Knowledge and Wisdom of Aboriginal Peoples in British Columbia

Nancy J. Turner; Marianne Boelscher Ignace; Ronald Ignace

Ecological Applications, Vol. 10, No. 5. (Oct., 2000), pp. 1275-1287.

Stable URL:
http://links.jstor.org/sici?sici=1051-0761%28200010%2910%3A5%3C1275%3ATEKAWO%3E2.0.CO%3B2-U

Ecological Applications is currently published by The Ecological Society of America.

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at http://www.jstor.org/about/terms.html. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at http://www.jstor.org/journals/esa.html.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is an independent not-for-profit organization dedicated to and preserving a digital archive of scholarly journals. For more information regarding JSTOR, please contact support@jstor.org.

http://www.jstor.org
Sun Feb 4 14:21:36 2007

Ecological Applications, 10(5), 2000, pp. 1275–1287
© 2000 by the Ecological Society of America

TRADITIONAL ECOLOGICAL KNOWLEDGE AND WISDOM OF ABORIGINAL PEOPLES IN BRITISH COLUMBIA

NANCY J. TURNER,[1,4] MARIANNE BOELSCHER IGNACE,[2] AND RONALD IGNACE[3,5]

[1]*School of Environmental Studies, University of Victoria, Victoria, British Columbia, Canada V8W 2Y2*
[2]*First Nations Studies and Anthropology, Secwepemc Education Institute and Simon Fraser University, 345 Yellowhead Highway, Kamloops, British Columbia, Canada V2H 1H1*
[3]*Department of Anthropology and Sociology, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6*

Abstract. This paper discusses the characteristics and application of Traditional Ecological Knowledge and Wisdom (TEKW) of aboriginal peoples in British Columbia, Canada. Examples are provided from various groups, most notably, the Secwepemc (Shuswap) Interior Salish and Kwakwaka'wakw and Nuu-Chah-Nulth peoples of the Northwest Coast, covering a range of features comprising TEKW: knowledge of ecological principles, such as succession and interrelatedness of all components of the environment; use of ecological indicators; adaptive strategies for monitoring, enhancing, and sustainably harvesting resources; effective systems of knowledge acquisition and transfer; respectful and interactive attitudes and philosophies; close identification with ancestral lands; and beliefs that recognize the power and spirituality of nature. These characteristics, taken in totality, have enabled many groups of aboriginal peoples to live sustainably within their local environments for many thousands of years. In order for TEKW to be incorporated appropriately into current ecosystem-based management strategies, the complete context of TEKW, including its philosophical bases, must be recognized and respected. A case study of ecological and cultural knowledge of the traditional root vegetables yellow avalanche lily (*Erythronium grandiflorum*) and balsamroot (*Balsamorhiza sagittata*) illustrates ways in which these components can be integrated.

Key words: Balsamorhiza sagittata; *Balsamroot; British Columbia Plateau;* Erythronium grandiflorum; *indigenous peoples; Northwest Coast; sustainable resource use; Traditional Ecological Knowledge and Wisdom; traditional land management; yellow avalanche lily.*

INTRODUCTION

We were born there and raised there and we understand the area.

—(Stanley Sam, Nuu-Chah-Nulth Elder from Ahousaht, and member of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, British Columbia)

Traditional ecological knowledge and wisdom (TEKW) of indigenous peoples has become a major focus of attention within the past decade (Freeman and Carbyn 1988, Johnson 1992, Berkes 1993, Doubleday 1993, Inglis 1993, Williams and Baines 1993). TEKW is acknowledged as having fundamental importance in the management of local resources, in the husbanding of the world's biodiversity, and in providing locally valid models for sustainable living. It has received major recognition as being complementary to, equivalent with, and applicable to scientific knowledge (Colorado and Collins 1987, Colorado 1988, Schultes 1988, Posey 1990, Gadgil et al. 1993, Hunn 1993, Corsiglia and Snively 1995, Salmón 1996, Richards 1997). On the international front, the Brundtland Report, *Our Common Future,* notes, "... the larger society ... could learn a great deal from their [indigenous peoples'] traditional skills in sustainably managing very complex ecological systems" (World Commission on Environment and Development 1987:115). Recent international agreements following from the 1992 United Nations Conference on Environment and Development (UNCED) meeting in Brazil, including the *Convention on Biological Diversity, Agenda 21,* and *Guiding Principles on Forests,* specifically recognize the important knowledge of indigenous and other long-resident peoples.

In this article, we examine characteristics of TEKW that pertain to the strategies for sustainable resource use of aboriginal peoples of British Columbia and neighboring areas. In particular, knowledge about plants and their cultural importance is exemplified as a major component and reflection of TEKW. Based on data from the Secwepemc (Shuswap) and other Northwestern peoples, we propose a model for analysis of

Manuscript received 1 December 1997; revised 26 January 1999; accepted 15 May 1999; final version received 29 July 1999. For reprints of this Invited Feature, see footnote 1, p. 1249.

[4] E-mail: nturner@uvic.ca
[5] Chief, Skeetchestn Band (Secwepemc).

TEKW systems, provide examples of their various features, and make recommendations about potential applications of TEKW. We contend that TEKW can enhance resource management practices, including ecological restoration, that currently are directed largely by scientific knowledge and westernized worldviews. The emerging holistic or ecosystem-based management of forestry and fisheries will particularly benefit from its input.

Indigenous peoples have resided in a particular locality for a long period of time, depending on the resources of their homelands. Many have become marginalized within nation states, although most have remained distinct linguistically and culturally, and continue to define themselves in relation to their home environment. Their concept of guardianship over their lands requires careful management and conservation by the present generation for the benefit of future generations: "We have to preserve and maintain our lands for the generations to come" (Mary Thomas, Secwepemc elder, *personal communication* to N. Turner, 1996). Indigenous peoples also connect their continuing guardianship and use of their ancestral lands to inherent aboriginal rights to those places. The concept of "Mother Earth" thus takes on local, as well as global, relevance.

Indigenous peoples are uniquely positioned in their close and long-standing environmental relationships, yet the survival of many indigenous cultures is severely threatened by insensitive economic development, by coersive education systems, by assimilation into the modes of production and inexorable movement toward market economies of the dominant society, and by the escalating ecological destruction of peoples' homelands and resources. Indeed, worldwide, the knowledge base for TEKW is threatened, and so are the possibilities for continued expression and reproduction of this knowledge and the mode of production that it engenders.

Indigenous peoples are diverse, and cannot be treated as a single entity, in opposition to industrial or post-industrial society. Each indigenous people has its own unique economic, practical, spiritual, political, and historical relationships to its homeland. Within indigenous societies, too, knowledge is not homogeneous. For example, differential knowledge among women and men in areas of plant and animal resource management is common. The degree of assimilation with the dominant society has also varied, and along with it, retention of traditions regarding resource management techniques and knowledge systems. However, traditional knowledge among younger generations, in most indigenous groups, has inevitably diminished as assimilation and environmental change have escalated.

The widely held anthropological distinction between food gatherers ("foragers") and food producers ("pastoralists/agriculturalists/horticulturalists") has created an artifical gap in the classification of resource management techniques between the former and the latter. As recent data on sustainable plant management among so-called gatherers from northwestern North America show (Blackburn and Anderson 1993, Anderson 1998, Loewen 1998, Peacock 1998, Peacock and Turner 2000; N. J. Turner and S. Peacock, *unpublished manuscript*), these peoples practiced a range of techniques of plant propagation, habitat management and enhancement, and soil fertilization that maximized the productivity of plant foods and materials. These management practices blur the division between foragers and horticulturalists, and challenge us to reexamine our own conceptual schemes regarding both hunter–gatherers and the respective roles of men and women in the production and reproduction of TEKW.

Traditional Ecological Knowledge and Wisdom of Indigenous Peoples of Northwestern North America

Fig. 1 provides a framework from which to present TEKW. Its general characteristics, as reflected in traditional cultures of our region, are categorized within three broad themes: practices and strategies for resource use and sustainability; philosophy or worldview; and communication and exchange of knowledge and information. These themes are complex and not subject to simple characterization, but each is developed as a general concept, and examples are provided from various cultural groups and experiences. In this paper, we focus not so much on *which* resources were (and are) used, as on the concepts surrounding their use: the attitudes about resources, the techniques and strategies applied to their use and the underlying rationales, and the formulation of these as "traditions" in the context of resource management. TEKW is recognized as holistic and not easily subject to fragmentation; the themes presented here are inextricably linked and interrelated. We close by discussing a case study of the use of avalanche lily and balsamroot.

Information in this study is drawn from many sources, including published ethnobotanical writings, ethnographies, ethnohistorical writings (as cited in Turner 1995*a*), and, most importantly, from accounts of aboriginal elders.

Practices and strategies for sustainable living

Practices of aboriginal peoples to maintain and enhance their lands, waters, and living resources are derived from generations of experimentation and observation, leading to an understanding of complex ecological and physical principles. In fact, aboriginal practices represent a dialectic relationship between those practices and peoples' belief systems. Management of plant resources is manifested in at least three levels: *populations,* as in harvesting and maintaining individual stands or patches of a plant species; *habitats,* as

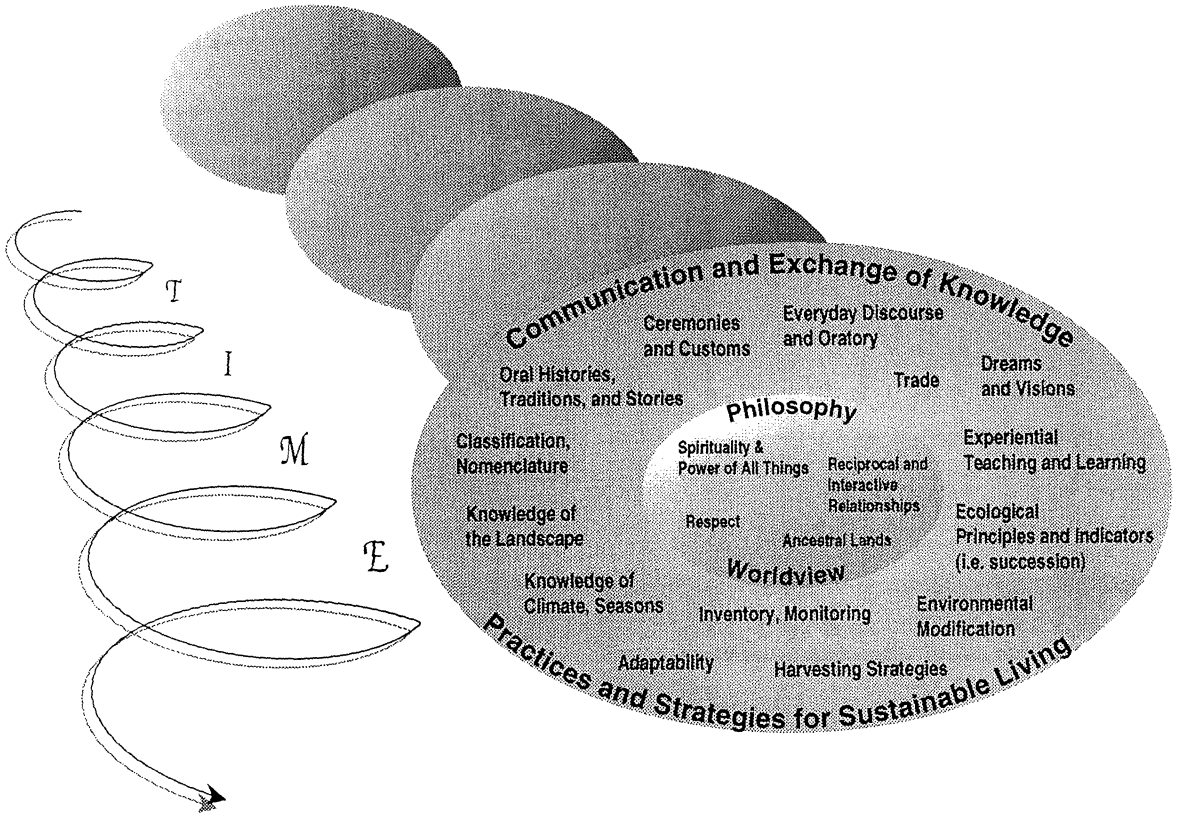

FIG. 1. Components of traditional ecological knowledge and wisdom of aboriginal peoples of northwestern North America.

with the use of fire to create and maintain particular successional stages conducive to the productivity of a complex of plant species; and *landscapes,* in which a host of strategies, including seasonal rounds leading to variable harvesting regimes, conventions relating to ownership and authority over resources, and culturally mediated prescriptions for humans' relationships to plants and animals, influence landscape development (see Peacock and Turner 2000).

Many of the techniques used by people to sustain the productivity of their plant resources are based on the fact that virtually all resource plant species in northwestern North America are perennials. Therefore, for example, unless an entire tree is required for construction or canoe making, individual plants are not generally destroyed. Instead, required parts are harvested from living plants having the capacity to regenerate. Thus, the inner bark of western red-cedar and yellow cedar was (and still is) harvested in quantity by Northwest Coast peoples for use in basketry, mats, cordage, and clothing (Turner 1998). However, seldom is bark of more than one-third of a tree's circumference removed, and the tree continues to live. Such living Culturally Modified Trees (CMTs) are a common sight in British Columbia's forests (Stryd 1997). They include not only cedars and birch trees used for their bark, but also trees with house planks split from them, various trees accessed for their edible cambium tissues, and trees and shrubs whose branches and boughs were taken for various purposes, from pit-cooking to use in the sweat house. Harvesting of bark for medicine is also done by cutting narrow strips from the trunk or by pruning branches (Turner and Hebda 1992). Even if, as in the case of harvesting root vegetables, an entire bulb or corm is removed, the harvesting is highly selective. Often, careful harvesting can lead to increased capacity for propagation. Even when large quantities of a plant product are harvested, the productivity of the plant populations can be maintained. Table 1 provides examples of various strategies used to maintain productivity of plant resources.

The efficacy and sustainability of these strategies is borne out in the quantities of resources that people consistently harvested over many, many generations. For example, root vegetables, such as spring beauty and avalanche lily for the Interior Salish St'at'imc and Nlaka'pamux, blue camas for the Straits and Halkomelem of southern Vancouver Island, and bitterroot for the Okanagan people, were harvested in immense quantities (Turner et al. 1990). Even a conservative accounting would have led to severe depletion of such resources unless they were in some way managed and

TABLE 1. Plant resources harvested and sustained by aboriginal peoples in northwestern North America.

Type of resource	Species examples	Sustainable harvesting method	References
Fibrous tree bark	western red-cedar, *Thuja plicata*; birch, *Betula papyrifera*	strip pulled off partial circumference of trunk; only outer birch bark harvested	Boas (1921), Stryd (1997), Turner (1998), Mary Thomas, *personal communication* to N. Turner, 1997
Wooden planks	western red-cedar	planks split from standing trees	Stewart (1984), Stryd (1997)
Bark for medicinal use	red alder, *Alnus rubra*; cascara, *Rhamnus purshiana*	narrow strip cut from four different trees	Turner and Hebda (1992)
Roots for basketry	red-cedar; Sitka spruce, *Picea sitchensis*	only a few roots taken from each tree	Turner (1998)
Fibrous stems and leaves for mats, cordage or baskets	cattail, *Typha latifolia*; tule, *Scirpus acutus*; stinging nettle, *Urtica dioica*; Indian-hemp, *Apocynum cannabinum*; slough sedge, *Carex obnupta*	cut from perennial plants at end of growing season; often only vegetative plants taken; plants regenerate next season	Turner (1998)
Withes and branches for basketry, rope, fish traps	saskatoon berry, *Amelanchier alnifolia*; hazelnut, *Corylus cornuta*; red-cedar; willow, *Salix* spp.	pruned from growing trees or bushes	Turner (1998)
Pitch for medicine, adhesives	western hemlock, *Tsuga heterophylla*; lodgepole pine, *Pinus contorta*; Sitka spruce; subalpine fir, *Abies lasiocarpa*; and other conifers	collected from natural human-made wounds in trees, or pitch blisters; not permanently damaging	Turner et al. (1990), Turner (1998); Christine Joseph, *personal communication* to N. Turner, 1999
Medicinal plants and roots	mountain valerian, *Valeriana sitchensis*; Indian hellebore, *Veratrum viride*	selectively harvested; often regenerated from fragments left in the ground (like a pulled-up dandelion in one's lawn)	Mary Thomas, *personal communication* to N. Turner, 1997
Edible berries, fruits and nuts	salmonberry, *Rubus spectabilis*; highbush cranberry, *Viburnum edule*; salal, *Gaultheria shallon*; hazelnut, *Corylus cornuta*; huckleberries, *Vaccinium* spp.; soapberries, *Shepherdia canadensis*	picked from bushes or from branches broken off from main bushes; sometimes bushes burned or pruned to renew their growth	Turner (1995, 1997, 1999)
Green leaves, shoots as vegetables	cow-parsnip, *Heracleum lanatum*; fireweed, *Epilobium angustifolium*; Indian celery, *Lomatium nudicaule*	picked selectively in spring from patches; plants perennial, and soon regenerate (e.g., like asparagus)	Turner (1995, 1997), Kuhnlein and Turner (1983)
Seaweed	red laver, *Porphyra perforata*	picked from rocks when young; plants allowed to regenerate	Turner (1995)
Root vegetables	blue camas, *Camassia* spp.; yellow avalanche lily, *Erythronium grandiflorum*; spring beauty, *Claytonia lanceolata*; balsamroot, *Balsamorhiza sagittata*; rice-root, *Fritillaria* spp.; springbank clover, *Trifolium wormskjoldii*; silverweed, *Potentilla anserina* ssp. *pacifica*	harvested selectively by size; smaller "roots" and propagules replanted; enhanced with tilling soil, sometimes weeding; burning said to enhance growth	Turner (1995, 1997, 1999), Turner and Kuhnlein (1982, 1983)
Edible tree cambium	western hemlock, Sitka spruce, black cottonwood, *Populus balsamifera* ssp. *trichocarpa*; pines, *Pinus* spp.	patch of bark removed, but trees not girdled	Stryd (1997), Turner (1987, 1995, 1997)
Edible mushrooms	pine mushroom, *Tricholoma magnivelare*; cottonwood mushroom, *T. populinum*	mature individuals cut at base; soil carefully replaced to protect those still growing	Turner et al. (1985), Turner (1997)

enhanced. Conversations with contemporary elders such as Mary Thomas and Kwakwaka'wakw Hereditary Chief Adam Dick confirm that these strategies were refined and intentional (N. J. Turner and S. Peacock, *unpublished manuscript*; see also the case study reported here).

Even when entire plants were removed, as in cutting trees, it was done in the context of ecological understanding. The trees cut down for house construction around the village of Skangwaii, on Haida Gwaii, for example, provided habitat on their stumps for growing salal, trailing currant, red huckleberries, and blueber-

ries, and thus the area became a berry garden for the people of the village (Captain Gold, *personal communication* to N. Turner, 1996). Trees were almost always harvested selectively, with standing forest cover being maintained. Mary Thomas was told long ago that her people usually waited until trees had died or were blown down in winter storms before they were taken for use in house construction (*personal communication* to N. Turner, 1995).

Plant resource use was (and is) imbued with ecological knowledge and wisdom that take many forms. Contemporaneous life cycles of different species; seasonal signals such as position and size of snow patches on the mountains, or the arrival of the first snow in the fall; relative numbers of particular birds in a given location; flowering of certain plants; and productivity of certain berries: all of these provide indicators for people to know when to expect a salmon run, when the clams are ready to be dug, or when particular roots are ready for harvesting (Turner 1997*b*). Regeneration of individual plants also has been widely recognized. Pruning or burning of certain berry bushes, for example, was formerly a common practice, and resulted in long-term enhanced yields. Basketry materials, too, were and are managed and enhanced by focused cutting, pruning, and burning (Turner 1996).

Ecological succession was and is also recognized by aboriginal peoples, as shown by their practice of landscape burning and the resultant enhancement of successional species (Gottesfeld 1994, Turner 1999). They also had an intimate understanding of the prime habitats for various cultural species, the conditions under which they were most productive, and the best methods for processing and storing them for the optimal utilization. Similar strategies were applied to the monitoring, management, and harvesting of salmon, shellfish, and game, where seasonal, age, and gender selection, and use of ecological indicators for population health was paramount.

Monitoring and control of specific resources was often undertaken by designated individuals, such as chiefs, and by families within a given territory. These people had the direct authority to manage specific fish stocks, plants, or shellfish beds, and if they noted populations in jeopardy, they could pronounce a harvesting moratorium until the situation improved (Richardson 1982; Chief Adam Dick and Daisy Sewid-Smith, *personal communication* to N. Turner, 1996). Surveying and observations were also carried out by hunters, as they traveled through the territory, and communicated the stage of plant growth (e.g., berry ripening, availability of root plants) to their partners or wives. Likewise, wives would exchange knowledge about animal resources with their husbands or other relatives as they gathered plants.

Philosophy and worldview

For traditionally schooled aboriginal people in many regions, the environment is seen as a whole; all the parts are interconnected in a seamless web of causes and effects, actions and outcomes, behaviors and consequences. People, animals, plants, natural objects, and supernatural entities are not separate and distinct. Rather, they are all linked to each other and to the places where they reside through cultural traditions and interactive, reciprocal relationships. Because of the integration of the secular with the spiritual, of the past with the present, and of all parts of the living universe, people have a sense of spiritual and practical respect for their lands, waters, and all the environmental components that they recognize. The spirituality of these elements, and their power to influence the success and well-being of humans, has been an integral part of traditional cultures. Ancient relationships tie all beings together in communities (Anderson 1996, Turner and Atleo 1998).

Indeed, more than any other single concept, it is the notion of *respect* for all life-forms and the land itself that characterizes North American belief systems. Resource management was carried out through a value system that enforced practices of sustainability, expressed as respect for all life-forms, and sanctioned individuals who were wasteful or "stingy." Notions of resource management sustained through forms of knowledge have been an integral part of the entire belief system, which stipulates spiritual connections among humans, animals, plants, and nature in general. Therefore, specific practices of resource management have expressed the "respect" that humans must show for all living things. Lack of respect was seen as resulting in spiritual sanctions from nature itself. Thus, aboriginal elders recall being told never to "play with" (i.e., playfully waste) animals or plants, which were perceived as giving themselves up for the benefit of humans. As Secwepemc elder Ida Matthew recalls, "It was pitiful enough that we had to kill them. [My mother] instilled in us that we were not to waste the food, that we had to kill the poor animal. With any kinds of animal that we would hunt and eat, you have to respect them." (*personal communication* to M. B. Ignace).

The essence of this attitude is revealed in part by the words of Charles Hill-Tout in his observations on the Lillooet First Salmon ceremony (Maud 1978:117):

> Nothing that the Indian of this region eats is regarded by him as mere food and nothing more. Not a single plant, animal, or fish, or other object upon which he feeds, is looked upon in this light, or as something he has secured for himself by his own wit and skill. He regards it rather as something which has been voluntarily and compassionately placed in his hands by the goodwill and consent of the "spirit" of the object itself, or by the intercession and magic of his culture-heroes; to be retained and used by him only upon the fulfilment of certain conditions . . . respect and reverent care in the killing or plucking of the

animal or plant and proper treatment of the parts he has no use for. . .

Mary Thomas (*personal communication* to N. Turner, 1997) has vivid memories of her grandmother walking along the banks of the Salmon River near her home after the sockeye had spawned, and pushing the dead salmon back into the river to float away in the current. This was undertaken with a combined sense of respect for the salmon and to nourish all the other life in the river. It was done all along the river by different people. The children, including Mary herself, were taught to do this and to respect the dead and dying salmon.

Many other indications of this respectful and interactive relationship between people and the resources they use are provided directly from elders' experiences and in the literature, for example, in the prescriptions for harvesting and using foods, materials, and medicines, in descriptions of the First Foods ceremonies, and in people's creation stories (Boas 1921, 1930, Charles Hill-Tout in Maud 1978:117, Turner 1997*b*, Sewid-Smith and Dick 1998, Turner and Atleo 1998). For example, the portrayal of the earth as having been created from a woman in the Nlaka'pamux story, "The Creation of the Earth by Old-One," and its variants (Teit 1912:321–322), supports the respectful and appreciative attitude towards the earth that is part of TEKW. The precarious relationship to the land and the need to respect it is also expressed by the Haida proverb: "The earth (land) is the same as the edge of a knife. When you are walking, watch your steps. If you don't watch your steps, you will fall off the earth" (from Boelscher 1989).

As noted previously, the practical strategies that people developed for maintaining their resources are inextricably linked with peoples' worldviews and philosophies. Thus, the care taken by a cedar-bark gatherer not to girdle the tree yielding the bark is drawn from the knowledge that the tree would die if all the bark were peeled off, and also reflects the recognition of the power and spirituality of the tree itself:

> Even when the young cedar-tree is quite smooth, they do not take all of the cedar-bark, for the people of the olden times said that if they should peel off all the cedar-bark . . . the young cedar would die, and then another cedar-tree near by would curse the bark-peeler so that he would also die. Therefore, the bark-peelers never take all of the bark off a young tree.
>
> —(Boas 1921:616–617; see also Schlick 1994)

All kinds of skills and practices have their foundations in such beliefs. At least part of peoples' care in fostering and caring for their lands and resources relates directly to the notions of the spirituality and influential powers in all things, including the earth, as exemplified in the Nlaka'pamux notion of "The Earth's Blanket": "[F]lowers, plants and grass especially the latter are the covering or blanket of the earth. If too much plucked or ruthlessly destroyed [the] earth [is] sorry and weeps[.] It rains or is angry & makes rain, fog & bad weather." (James Teit, ethnographer, *unpublished notes* on Nlaka'pamux [or Thompson] plant knowledge, around 1900, cited from Turner et al. 1990: 54). This general indigenous sense of respect for the Earth as "Mother" in our opinion does not contradict the fact that particular aboriginal peoples had particular guardianship relations, ideological bonds, and rights to their own ancestral lands. It is important to distinguish this relationship with particular aboriginal territories from the more widely mentioned guardianship of "Mother Earth" often invoked by contemporary environmentalists.

Communication and exchange of knowledge and wisdom

Integral to the systems of TEKW are the processes by which knowledge is communicated and transmitted among people, and from one generation to the next. Knowledge transfer occurs in many ways, and through many culturally mediated venues, beginning with the instruction of children by parents and grandparents, and by children's participation in and observation of management activities. Language is integral to the process of knowledge transfer, and one of the most serious and insidious obstacles to the perpetuation of TEKW in our region was the imposition of the Residential School system for indigenous children over the last century, in which their languages were forcibly suppressed and effectively eliminated. The widespread loss of specialized vocabulary (such as names for plants, animals, and places) and discourse associated with peoples' relationships to the land and the various life-forms is a major tragedy; yet the concepts are at least partially retained to the present day.

Although banned through federal Canadian legislation for several decades, major cultural institutions such as potlatches, feasts, first foods ceremonies, and systems of designated authority have been, and continue to be, vitally important in TEKW. For example, the Nuu-Chah-Nulth concept of HaaHuulhi, in which the recognized authority and responsibility over specific lands and resources is designated through hereditary prescription to individual chiefs, leads to intimate knowledge of specific places by individuals. They are instructed about these places and resources, and how to care for them, from the time that they are very young. They are taught the philosophies associated with the use of the land and specific practical strategies, such as maintaining and caring for salmon spawning beds and pools in a particular river (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, 1995*a*). Comparable systems of stewardship and proprietorship over lands and resources were in place throughout the region.

Children's participation in harvesting and manage-

ment of traditional foods and materials is crucial; children gain practical knowledge and experience through observation and assisting their elders, parents, and grandparents. Mary Thomas and her siblings gathered up the avalanche lily and riceroot bulbs from the turf their grandmother turned over with her digging stick. Then, they watched as she examined the "roots" they had put into the basket, picking out the smaller ones and replacing them in the soil to grow for the future years. This is how they learned to manage the root resources. As a child, Chief Adam Dick learned similar skills and knowledge as he helped to harvest his family's riceroot patches at Kingcome Inlet (*personal communication* to N. Turner, 1997).

Narratives, told over and over again to children and adults alike, were another highly important mode of communicating TEKW. Stories such as "Coyote Juggles His Eyes" and the "Star Husband Tales" are imbued with lessons in ecology and proper ways of relating to others. A good example is the story told to Mary Thomas by her grandmother about trembling aspen (*Populus tremuloides*). When all the trees were created, Trembling Aspen would not bow down and recognize Mother Nature, its creator. As a punishment for this lack of respect, Aspen was made to tremble and shake its leaves continuously, which it still does. This story emphasized to children that they must respect their parents and their Creator (Mary Thomas, *personal communication* to N. Turner, 1997).

Many of the concepts, themes, and specific details of TEKW are widely held among different language and cultural groups in the region. Trading and other forms of intergroup communication have contributed to the commonalities of understanding (Turner and Loewen 1998). Comparisons of the names of plants and animals and associated terminology, as well as of narratives and ceremonies, can reveal some of the past ties and connections among peoples' knowledge systems (Turner et al. 1998).

Case Study: Avalanche Lily and Balsamroot

The traditional management of wild root crops in south-central British Columbia is a good example of how the many facets of TEKW are woven together to provide ecologically sustainable, nutritious, and culturally valued food sources. From this knowledge, too, ecologists and restorationists can acquire important baseline data to help in restoring degraded habitats, in gaining a better understanding of humans' role in shaping the environment, and in providing other important information, e.g., requirements for prescribed burning regimes and knowledge of feeding habits of grizzly bear and other wildlife species.

Although aboriginal peoples of the Interior Plateau are generally assumed to have derived most of their sustenance from salmon and game, plant foods have contributed to their diets in major ways, both quantitatively and qualitatively. Of the plant products eaten, roots and other underground parts were primary sources of carbohydrates, dietary fiber, and essential vitamins and minerals (Kuhnlein and Turner 1991, Hunn et al. 1998).

Recent work on yellow avalanche lily (*Erythronium grandiflorum*) and balsamroot (*Balsamorhiza sagittata*), particularly that of Loewen (1998) and Peacock (1998), has revealed complex relationships pertaining to plant ecology (harvesting practices, management, seasonality, species distribution, interspecific interactions); human health and nutrition (nutritional value, famine foods, medicine); technological innovations (processing and cooking, storage); and cultural aspects of plant use (social structure, education, language and classification, trade and exchange, narratives, and ceremonial and religious practices). In this section, we summarize briefly some of these relationships as they pertain to these two species. There are countless other such examples.

*Avalanche lily (*Erythronium grandiflorum *Pursh)*

Yellow avalanche lily, or glacier lily (Fig. 2) is widely distributed in south-central British Columbia, mostly in montane regions, but extending onto lower hillsides and valleys around Shuswap Lake. Its primary use among Plateau peoples is its edible bulbs, which formerly were harvested in large quantities, evidently ~100 kg per family per year for the Secwepemc around Chase (Palmer 1975).

The bulbs were generally harvested at their fruiting stage, when the leaves start to turn yellowish. The exact timing of this stage varied according to elevation, so that people could start harvesting the bulbs in lowland areas in May and June, and extend their harvesting into the montane meadows through July and early August. Only the largest bulbs were selected; these were determined by choosing stems with multiple fruiting capsules, indicating the most mature plants, or possibly those genetically disposed toward large size. Mary Thomas (*personal communication* to N. Turner and D. Loewen, 1997) noted that the bulbs are only good at a certain stage in their development; if dug too early, they were too soft, and after their "ripe" stage, they became too watery and were no longer considered edible.

Harvesting the bulbs involved prying up a section of turf, discarding the upper layer containing competing grasses and other species, then turning over the loamy soil, selecting the largest bulbs, and replanting the small ones. Because the seed capsules would have been mature, intentional or incidental scattering of seeds into the freshly tilled soil would have enhanced the propagation of the plants. As well, the small propagule attached to the lower part of the bulb was intentionally removed and replanted, or saved and later returned to the digging site, according to Mary Thomas.

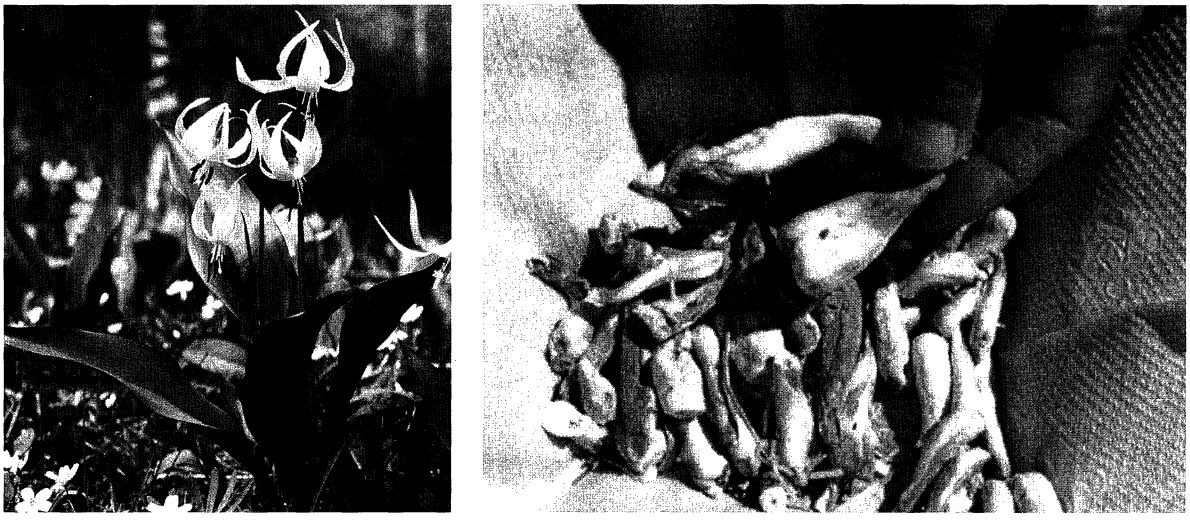

FIG. 2. Left: Yellow avalanche lily, or yellow glacier lily, *Erythronium grandiflorum* (Liliaceae). Right: Dried bulbs of *E. grandiflorum.*

She also noted that people would leave the dug-over locality alone for three or four years after an intensive harvest, moving to another location in the interim. After this time, the younger bulbs would have matured and would be ready for further harvest. The continuous digging and tilling of the soil, weeding, and breaking up and spreading of clumped bulbs evidently optimized the productivity of the lilies, for the preferred harvesting grounds are those that traditionally have been dug intensively.

Sometimes people left the bulbs, once dug, to "wilt" out on the ground at the digging site. This was to make them easier to thread and dry, but also, according to some people, the process made them taste sweeter, apparently because more sugars were produced. The carbohydrate content of the bulbs changes considerably with life cycle stage, as well as with processing (Loewen 1998), and this undoubtedly influenced their taste, digestibility, and energy contributions.

Several other root vegetables grow together with the avalanche lily, notably spring beauty (*Claytonia lanceolata*), riceroot (*Fritillaria lanceolata*), tiger lily (*Lilium columbianum*), and nodding onion (*Allium cernuum*). Not surprisingly, peoples' seasonal movements over their territories were guided in large measure by the presence and availability of these and other plant resources. The "roots" were dug concurrently, and some of the management practices pertaining to avalanche lily also influenced the use and productivity of the other species. In particular, all of these species are noted to have been enhanced in quality and productivity through controlled landscape burning (Turner 1999). The roots were often stored and served together in special dishes with other ingredients such as dried saskatoon berries (*Amelanchier alnifolia*), deer fat, salmon eggs, and black tree lichen (*Bryoria fremontii*), to provide highly nutritious and well-balanced food combinations (Turner et al. 1990). Additionally, the bulbs were known to be valued as accessible, predictable food in time of food shortage, when fish and game were not available (Turner and Davis 1993).

Avalanche lily bulbs are also known to be eaten by grizzly bears and by various small rodents. People were very familiar with the foods of animals, and often used their observations to enhance their own diets. For example one St'at'imc elder from Mount Currie (A. Peters, *personal communication* to N. Turner, 1984) recalled seeing grizzly bears digging avalanche lily up in the subalpine parklands, turning over the turf to leave the bulbs exposed to the sun and air for a few days before returning to consume them:

> You've got to go pretty well up the top of a mountain for it [k'ám'ts, *Erythronium* bulbs], the summit. In a certain time of the year they pick it. . . . The old-timers used to pick it and dry it for winter use. I know the grizzly bears they dig it out too. They use their big claws like that [raking motion], and they just leave it like that in the sun, you know. I guess they must taste good when they're dry. They don't eat it right away. I've watched them. A long time, I've watched the grizzly bear, digging it out. I've seen them k'ám'ts laying like that. . . .

It is quite likely that people first learned of the edibility of these bulbs from observing the feeding habits of grizzlies, and possibly learned to "wilt" the bulbs from these animals as well. Sometimes, too, people availed themselves of the stored roots of small mammals from their underground storage caches, but they were always careful to leave some of the roots, or to leave a gift of

FIG. 3. Left: Balsamroot or spring sunflower, *Balsamorhiza sagittata* (Asteraceae). Right: Harvested roots of *B. sagittata*, to be peeled and pit-cooked before being eaten.

grain or other food for the rodents in return for their "gift."

*Balsamroot (*Balsamorhiza sagittata *(Pursh) Nutt)*

Balsamroot, or spring sunflower, is a member of the Asteraceae (Fig. 3) and produces multiple foods for Plateau peoples: taproots, young shoots, flower bud stalks, and achenes. The roots, little used at present, were formerly pit-cooked and eaten in quantity. This species is wide-ranging throughout the interior plateau, from the lower valley slopes into upland valleys such as Botanie Valley, near Lytton, in grasslands and open woodlands (Turner 1997*a*). Some people say that the lowland plants produce the best roots for eating (Turner et al. 1990). As with avalanche lily, however, the roots, which were usually dug in the spring before flowering, could be harvested progressively from the lowlands to farther up in the mountains as the season advanced.

The ideal size of root to harvest was from plants with 6–12 leaves and taproots about the size of carrots. The largest roots, probably several decades old, in some cases, were called the "mother" roots, and they were never dug as food. They produced up to 40 or 50 leaves and 20–30 flowerheads. These mother roots could be as large as one's forearm, and could extend half a meter into the ground. In traditional harvesting regimes, they would serve as a source of seeds for food, and also for continuing propagation of the species.

Once dug, the roots were cooked, dried, and stored. They were also used medicinally, being boiled to produce a resin that was used as a poultice for burns, cuts, and other wounds. The powdered leaves of balsamroot were also used on wounds to reduce infections (Mary Thomas, *personal communication* to N. Turner, 1996). Balsamroot is considered to have many "relatives" such as arnica (*Arnica* spp.) and brown-eyed Susan (*Gaillardia aristata*). Ecologically, it is associated with other food plants such as prickly pear (*Opuntia* spp.), mariposa lily (*Calochortus macrocarpus*), desert parsley (*Lomatium macrocarpum*), and yellowbells (*Fritillaria pudica*).

Preparation of root crops for consumption

Traditionally, both avalanche lily bulbs and balsamroots were pit-cooked, before or after being dried. Pit cooking is a complex and highly effective method for cooking and flavoring large quantities of root vegetables and other foods such as deer meat, fish, and shellfish. Various pit-cooking recipes were used throughout the Northwest Coast and the Interior Plateau (cf. Turner 1995*b*, 1997*a*, Turner et al. 1983, 1990). In cooking pits, vegetation such as Douglas-fir boughs (*Pseudotsuga menziesii*), branches of certain shrubs, or damp grass surrounded the food as it cooked. In experimental reconstruction, the pit temperature can reach 100°C after a couple of hours, and relatively high temperatures are sustained for many hours. Some foods, including both avalanche lily bulbs and balsamroots, were left to cook for 24 hours or more. Chemical conversions have been demonstrated for pit-cooked foods, in which complex carbohydrates such as inulin (a complex sugar with fructose as basic units) are significantly reduced into simpler forms, producing more digestible and probably more palatable end products (Kuhnlein and Turner 1991, Loewen 1998, Peacock 1998).

Pit-cooking practices extend well back in the archaeological record, and are apparently indicative of intensification of root use as important foods >2000 years ago (Pokotylo and Froese 1983, Peacock 1998). The use of root diggers also has ancient origins: handles of root-digging sticks dating to ~2400 years ago have been found in the Plateau region near Kamloops and Chase. The antiquity of intensive root harvesting attests

to its ecological sustainability and to the success of the various practices applied in its promotion.

Cultural and linguistic context

Both avalanche lily and balsamroot, as well as other food resources, depended upon the harvesting, processing, and preparation of a number of other resources: the woods used for making the digging sticks; the birch bark (*Betula papyrifera*), red-cedar root (*Thuja plicata*), and cherry bark (*Prunus emarginata*) for the baskets needed to transport the roots; the maple bark (*Acer glabrum*) used to string the bulbs or roots for drying; the Indian hemp (*Apocynum cannabinum*) fiber, silverberry (*Elaeagnus commutata*), or other fibers used for weaving storage bags; and the fuel and vegetation used for cooking and flavoring them (Turner 1996, 1997*a*, 1998).

There are names for avalanche lily and balsamroot in all four Interior Salish languages in British Columbia, as well as in Tsilhqot'in, Carrier, and other neighboring languages. The names for avalanche lily are from two distinct linguistic lines, both apparently unanalyzable in these languages (Turner et al. 1990), indicating a probable long-term association of these peoples with the plant. For the versatile balsamroot there are, in some cases, separate and specific names for the various edible parts (see Turner et al. 1990). Conceptually, these plants are often considered together in a broad, but generally unnamed, category of "edible roots," resources that share many commonalities in harvesting, management, processing, storage, and serving, and play similar roles in traditional diets.

Many places are named after these root plants around the southern Interior. For example, there is flat area in Botanie Valley (which is a famous root-harvesting valley in Nlaka'pamux territory) called *k'em'k'em'ats-útsiyem'cw* after the avalanche lily that grows there abundantly. People were also sometimes named after these plants (Turner et al. 1990).

Women were the major harvesters of root vegetables, using pointed wooden or antler digging sticks. Children also participated, learning the techniques and sizes to select from their mothers and grandmothers. Women were also the main processors and preparers of these foods, and were generally the ones to determine what quantities should be harvested, what types of processing and storage should be used, and how much might be available for trade.

Both avalanche lily and balsamroot feature in many traditional narratives, particularly those involving grizzly bears and avalanche lily (Teit 1898, 1912). Balsamroot was associated with several rituals relating to its preparation (Teit 1900, Turner et al. 1990, Peacock, 1998). For example, Nlaka'pamux women, while digging or cooking the roots, had to abstain from sexual intercourse. A man was not to come near the cooking pit while the roots were being cooked. Women often painted their faces red, or painted a large black or red spot on each cheek, when they went to dig the roots. Prayers were offered to the balsamroot plant by young people when eating the first berries, roots, or other foods of the season: "I inform thee that I intend to eat thee. Mayest thou always help me to ascend so that I may always be able to reach the tops of mountains, and may I never be clumsy! I ask this from these, Sunflower-root. Thou are the greatest of all in mystery" (Teit 1900:349). There were also taboos against a bereaved spouse eating balsamroot for a whole year after the bereavement (Teit 1900).

Contemporary status of traditional root vegetables

It is ironic that contemporary elders like Mary Thomas have noticed a distinct deterioration in the quality and productivity of root vegetables such as avalanche lily and balsamroot. Mary Thomas (*personal communication* to N. Turner, 1995) summarized her observations of the impacts of cattle on traditional Secwepemc root vegetables:

> Everything is deteriorating—the surface of the soil where we used to gather our food, there's about 4 to 6 inches of thick, thick sod and all introduced [plants]. And on top of that the cattle walk on it, and it's packing it to the point where there's very little air goes into the ground, very little rain, and it's choking out all the natural foods [e.g., rice-root, avalanche lily, spring beauty], and it's going deeper and deeper, and the deeper they go the smaller they're getting.

She said that her grandmothers and mother would not even consider harvesting avalanche lily bulbs that were smaller than 2.5 cm across and 7–8 cm long. Now, because of the cattle and the dense turf, and because people are not digging these roots any more, it is almost impossible to find plants with bulbs of this size. She also observed that much of the prime digging meadowlands for avalanche lily are being innundated by shrubs such as black hawthorn (*Crataegus douglasii*). This is because people are not burning the way they did formerly. Gradually, she believes, these meadows will be completely covered with bush.

She recalled, from her childhood, seeing the horses run through the fields of balsamroot in the Neskonlith Meadows near Chase; their bellies were colored yellow by the pollen of the flower heads, so high and lush-growing were the plants. Now, because of the trampling of cattle and introduced weeds, the balsamroot plants are only about 30–40 cm high, and are almost impossible to dig. Obviously, if we want to try to restore such areas, these observations are invaluable.

Summary of case studies

These descriptions of the ecological and cultural aspects of these two important root vegetables incorpo-

rate some of the complexities and interactive elements of TEKW for the Interior Salish peoples. Virtually all of the culturally important plants of British Columbia, as well as other areas of North America, are underlain by equally rich and significant traditional knowledge. If ecologists, resource managers, and restorationists are to truly understand these resources and the ecological and cultural systems that support them, they will need to recognize and rely more fully on TEKW of indigenous peoples.

Conclusions

In looking for answers and solutions to ecological dilemmas that we face, such as loss of biodiversity and imperatives for restoration of degraded lands, it is important to respect, recognize, and apply TEKW of indigenous peoples, with their full participation and collaboration. There are good models for integrating TEKW in ecosystem management decision making in ethical and effective ways (e.g., Osherenko 1988, Pinkerton 1989, Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995*a*, *b*), but more need to be developed. All of us, scientists and nonscientists alike, are looking for a more complete understanding of ecosystems, so that we can better care for them and alleviate some of the damage that we have done. TEKW provides answers, not only in terms of detailed observations of particular localities and resources, but also in terms of philosophies and methods of acquiring and communicating knowledge that can enrich our lives and help us to achieve a better, more sustainable relationship with our environment.

Acknowledgments

We acknowledge with sincere thanks and appreciation the many aboriginal people who have shared their knowledge and wisdom with us, especially Mary Thomas, Nellie Taylor, Ida William, and Ida Matthew (Secwepemc); Alec Peters (St'at'imc); Dr. Richard Atleo (Chief Umeek), Chief Earl Maquinna George, and Stanley Sam (Nuu-Chah-Nulth); Dr. Daisy Sewid-Smith, Kim Recalma-Clutesi, Chief Adam Dick (Kwaxistala), and Christine Joseph (Kwakwaka'wakw); and Captain Gold (Haida). Brenda Beckwith and Dawn Loewen provided us with technical support in developing the figures. This work was made possible through a grant from the Social Sciences and Humanities Research Council of Canada (#410–94–1555; N. Turner, principal investigator). The paper was first presented in March 1996, at the Society of Ethnobiology Conference at Santa Barbara, California, USA.

Literature Cited

Anderson, E. N. 1996. Ecologies of the heart: emotion, belief and the environment. Oxford University Press, New York, New York, USA.

Anderson, M. K. 1998. From tillage to table: The indigenous cultivation of geophytes for food in California. Journal of Ethnobiology **17**(2):149–170.

Berkes, F. 1993. Traditional ecological knowledge in perspective. Pages 1–9 *in* J. T. Inglis, editor. Traditional ecological knowledge: concepts and cases. International Program on Traditional Ecological Knowledge, Canadian Museum of Nature, Ottawa, Ontario, Canada.

Blackburn, T. C., and M. K. Anderson, editors. 1993. Before the wilderness: environmental management by Native Californians. Ballena Press, Menlo Park, California, USA.

Boas, F. 1921. Ethnology of the Kwakiutl. Bureau of American Ethnography, 35th Annual Report, 1913–1914. Smithsonian Institution, Washington, D.C., USA.

Boas, F. 1930. Religion of the Kwakiutl Indians. Columbia University Press, New York, New York, USA.

Boelscher, M. 1989. The curtain within: Haida social and mythical discourse. University of British Columbia Press, Vancouver, British Columbia, Canada.

Colorado, P. 1988. Bridging Native and Western science. Convergence **21**(2/3):49–59.

Colorado, P., and D. Collins. 1987. Western scientific colonialism and the re-emergence of Native science. Practice: Journal of Politics, Economics, Psychology, Sociology and Culture, Winter 1987:50–65.

Corsiglia, J., and G. Snively. 1995. Global lessons from the traditional science of long resident peoples. Pages 25–51 *in* G. Snively and A. MacKinnon, editors, Thinking globally about mathematics and science education. Centre for the Study of Curriculum and Instruction, University of British Columbia, Vancouver, British Columbia, Canada.

Doubleday, N. C. 1993. Finding common ground: natural law and collective wisdom. Pages 41–53 *in* J. T. Inglis, editor. Traditional ecological knowledge: concepts and cases. International Program for Traditional Ecological Knowledge, IDRC, Ottawa, Ontario, Canada.

Freeman, M. R., and L. N. Carbyn. 1988. Traditional knowledge and renewable resource management in northern regions. International Union for the Conservation of Nature, Commission on Ecology and Boreal Institute for Northern Studies, Edmonton, Alberta, Canada.

Gadgil, M., F. Berkes, and C. Folke. 1993. Indigenous knowledge for biodiversity conservation. Ambio **22**(2–3):151–156.

Gottesfeld, L. M. J. 1994. Aboriginal burning for vegetation managment in northwest British Columbia. Human Ecology **22**(2):171–188.

Hunn, E. N. 1993. What is traditional ecological knowledge? Pages 13–15 *in* N. M. Williams and G. Baines, editors. Traditional ecological knowledge: wisdom for sustainable development. Centre for Resource and Environmental Studies, Australian National University, Canberra, Australia.

Hunn, E. S., N. J. Turner, and D. H. French. 1998. Ethnobiology and subsistence. Pages 525–545 *in* D. E. Walker, editor. Plateau. Volume 12, Handbook of North American Indians (W. C. Sturtevant, General Editor). Smithsonian Institution, Washington, D.C., USA.

Inglis, J. T., editor. 1993. Traditional ecological knowledge: concepts and cases. International Program on Traditional Ecological Knowledge, IDRC, Ottawa, Ontario, Canada.

Johnson, M., editor. 1992. LORE: Capturing traditional environmental knowledge. IDRC, Ottawa, Ontario, Canada.

Kuhnlein, H. V., and N. J. Turner. 1991. Traditional plant foods of Canadian indigenous peoples. Nutrition, botany and use. *In* S. Katz, editor. Food and nutrition in history and anthropology. Volume 8. Gordon and Breach Science Publishers, Philadelphia, Pennsylvania, USA.

Loewen, D. L. 1998. Ecology, ethnobotany, and nutritional aspects of yellow glacier lily, *Erythronium grandiflorum* Pursh (Liliaceae) in Western Canada. Thesis. University of Victoria, Victoria, British Columbia, Canada.

Maud, R., editor. 1978. The Salish people: the local contribution of Charles Hill-Tout. Volume II: The Squamish and the Lillooet. Talonbooks, Vancouver, British Columbia, Canada.

Osherenko, G. 1988. Sharing power with Native users: comanagement regimes for native wildlife. Canadian Arctic

Resources Committee Policy Paper Number 5, Ottawa, Ontario, Canada.

Palmer, G. 1975. Shuswap Indian ethnobotany. Syesis **8**:29–81.

Peacock, S. 1998. Putting down roots: root food production in the Canadian Plateau. Dissertation. University of Victoria, Victoria, British Columbia, Canada.

Peacock, S., and N. J. Turner. 2000. Just like a garden: traditional plant resource management and biodiversity conservation on the British Columbia Plateau. Pages 133–179 *in* P. Minnis and W. Elisens, editors. Biodiversity and Native North America. University of Oklahoma Press, Norman, Oklahoma, USA.

Pinkerton, E. 1989. Introduction: attaining better fisheries management through co-management: prospects, problems, and propositions. *In* E. Pinkerton, editor. Co-operative management of local fisheries: new directions for improved management and community development. University of British Columbia Press, Vancouver, British Columbia, Canada.

Pokotylo, D. L., and P. D. Froese. 1983. Archaeological evidence for prehistoric root gathering on the southern Interior Plateau of British Columbia: a case study from upper Hat Creek Valley. Canadian Journal of Archaeology **7**(2): 127–57.

Posey, D. A. 1990. The science of the Mebêngôkre. Orion **9**(3):16–21.

Richards, R. T. 1997. What the Natives know: wild mushrooms and forest health. Journal of Forestry, September 1997:5–10.

Richardson, A. 1982. The control of productive resources on the Northwest Coast of North America. Pages 93–112 *in* N. M. Williams and E. S. Hunn, editors, Resource managers: North American and Australian hunter-gatherers. American Association for the Advancement of Science Selected Symposia Series, Washington, D.C., USA.

Salmón, E. 1996. Decolonizing our voices. Winds of Change, Summer 1996:70–72.

Schlick, M. D. 1994. Columbia River basketry: gift of the ancestors, gift of the earth. University of Washington Press, Seattle, Washington, USA.

Schultes, R. E. 1988. Primitive plant lore and modern conservation. Orion **7**(3):8–15.

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. 1995*a*. First Nations' perspectives relating to forest practices standards in Clayoquot Sound. March 1995. Victoria, British Columbia, Canada.

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound. 1995*b*. A vision and its context: global context for forest practices in Clayoquot Sound. Report 4. March 1995. Victoria, British Columbia, Canada.

Sewid-Smith, D., and Chief A. Dick, Interviewed by N. J. Turner. 1998. The sacred Cedar tree of the Kwakwa-ka'wakw People. Interview with Daisy Sewid-Smith (Mayanilh) and Chief Adam Dick (Kwaxsistala). Pages 189–209 *in* M. Bol, editor. Stars above, earth below: Native Americans and nature. Background Book for Alocoa Foundation Hall of Native Americans Exhibit. Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA.

Stewart, H. 1984. Cedar. Tree of life to the Northwest Coast Indians. Douglas and McIntyre, Vancouver, British Columbia, Canada.

Stryd, A. H. 1997. Culturally modified trees of British Columbia: a handbook for the identification and recording of culturally modified trees. British Columbia Ministry of Forests, Victoria, British Columbia, USA.

Teit, J. A. 1898. Traditions of the Thompson River Indians of British Columbia. American Folklore Society, Houghton, Mifflin, New York, New York, USA.

Teit, J. A. 1900. The Thompson Indians of British Columbia. American Museum of Natural History, Memoir Number 2. New York, New York, USA.

Teit, J. A. 1912. Mythology of the Thompson Indians. Volume VII. Memoir of the American Museum of Natural History. F. Boas, editor. The Jesup North Pacific Expedition. New York, New York, USA.

Turner, N. J. 1995*a*. Ethnobotany today in Northwestern North America. Pages 264–283 *in* R. E. Schultes and S. von Reis, editors. Ethnobotany: evolution of a discipline. Dioscorides Press, Portland, Oregon, USA.

Turner, N. J. 1995*b*. Food plants of coastal First Peoples [revised from 1975 edition, Food plants of British Columbia Indians. Part 1. Coastal Peoples]. University of British Columbia Press, Vancouver, Canada, and Royal British Columbia Museum, Victoria, Canada.

Turner, N. J. 1996. "Dans une Hotte." L'importance de la vannerie das l'économie des peuples chasseurs-pêcheurs-cueilleurs du Nord-Ouest de l'Amérique du Nord ["Into a basket carried on the back." Importance of basketry in foraging/hunting/fishing economies in northwestern North America]. Anthropologie et Sociétiés. Special Issue on Contemporary Ecological Anthropology. Theories, Methods and Research Fields. Montréal, Québec, **20**(3):55–84. (In French).

Turner, N. J. 1997*a*. Food plants of interior First Peoples. (revised from 1978 edition, Food plants of British Columbia Indians. Part 1. Interior Peoples), University of British Columbia Press, Vancouver, Canada, and Royal British Columbia Museum, Victoria, Canada.

Turner, N. J. 1997*b*. Traditional ecological knowledge. Pages 275–298 *in* P. K. Schoonmaker, B. Von Hagen, and E. C. Wolf, editors. The rain forests of home: profile of a North American bioregion. Ecotrust. Island Press, Covelo, California, USA.

Turner, N. J. 1998. Plant technology of British Columbia First Peoples. (revised from the 1979 edition, Plants in B.C. Indian technology), University of British Columbia Press, Vancouver, Canada, and Royal British Columbia Museum, Victoria, Canada.

Turner, N. J. 1999. "Time to Burn": Traditional use of fire to enhance resource production by Aboriginal Peoples in British Columbia." Pages 185–218 *in* R. Boyd, editor. Indians, fire and the land in the Pacific Northwest. Oregon State University Press, Corvallis, Oregon, USA.

Turner, N. J., and E. R. Atleo (Chief Umeek). 1998. Pacific North American First Peoples and the environment. Pages 105–124 *in* H. Coward, editor. Environment and development values in the Pacific. Center for Studies in Religion and Society, University of Victoria, Canada, and State University of New York, Albany, New York, USA.

Turner, N. J., and A. Davis. 1993. "When everything was scarce": The role of plants as famine foods in northwestern North America. Journal of Ethnobiology **13**(2):1–28.

Turner, N. J., and R. J. Hebda. 1992. Contemporary use of bark for medicine by two Salishan Native elders of southeast Vancouver Island. Journal of Ethnopharmacology **229**(1990):59–72.

Turner, N. J., M. B. Ignace, and B. D. Compton. 1998. Secwepemc (Shuswap) tree names: Key to the past? Pages 387–417 *in* E. Czaykowska-Higgins and M. D. Kinkade, editors. Salish languages and linguistics. Theoretical and descriptive perspectives. Trends in Linguistics, Studies and Monographs 107. Mouton de Gruyter, New York, New York, USA.

Turner, N. J., and D. C. Loewen. 1998. The original "free trade": exchange of botanical products and associated plant knowledge in northwestern North America. Anthropologica **60**:49–70.

Turner, N. J., J. Thomas, B. F. Carlson, and R. T. Ogilvie.

1983. Ethnobotany of the Nitinaht Indians of Vancouver Island. British Columbia Provincial Museum Occasional Paper Number 24, Victoria, British Columbia, Canada.

Turner, N. J., L. C. Thompson, M. T. Thompson, and A. Z. York. 1990. Thompson ethnobotany: knowledge and usage of plants by the Thompson Indians of British Columbia. Royal British Columbia Museum, Memoir Number 3, Victoria, British Columbia, Canada.

Williams, N. M., and G. Baines, editors. 1993. Traditional ecological knowledge: wisdom for sustainable development. Based on Traditional Ecological Knowledge Workshop, April 1988, Centre for Resource and Environmental Studies, Australian National University, Canberra, Australia.

World Commission on Environment and Development. 1987. Our common future. Oxford University Press, Oxford, UK.